User Manual:

U.S. Environmental Protection Agency's

Continuous Emission Monitoring System

Cost Model

Version 3.0

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1.0 INTRODUCTION

This document is the user's manual for Version 3.0 of the U. S. Environmental Protection Agency (EPA's) continuous emission monitoring system (CEMS) Cost Model. For version 3.0, the model was converted to run in a Windows environment. In addition, costs were updated to reflect changes in the market since release of the original model in 1991, and the methodology was modified to estimate costs for additional types of monitors.

The manual provides information about the basis for the model and the costing methodology, instructions on how to run the model, example inputs and outputs for a sample CEMS, and instructions on how to tailor the model for site-specific applications. This manual assumes the user has a basic understanding of Windows.

The remainder of this manual is divided into 3 sections, with 3 Appendices. Section 2.0 provides installation instructions. Section 3.0 describes the basis for the model, including assumptions used in developing the model, and the costing methodology. Section 4.0 presents step-by-step instructions for running the model, sample input and output screens for an example CEMS, and procedures for tailoring the model for a site-specific application. The Appendices contain tables of default labor estimates and linear adjustment factors.

2.0 INSTALLATION INSTRUCTIONS

2.1 Set Up Procedures

The CEMS Cost Model program is contained in a file called CEMS.exe on the OAQPS/EMTIC web BBS (www.epa.gov/ttn/). The downloading procedure instructs you to save CEMS.exe to a folder on your hard drive. Note, save CEMS.exe in a temp folder/directory. After the file is downloaded, install the program by running (double-click) the CEMS.exe file in the temp folder. This action opens the self-extractor window from which you unzip (extract) the files in CEMS.exe and name the folder into which the extracted files will be saved (recommend a folder called CostModel on your hard drive).

If the box "run setup automatically" in the self-extractor window is checked, the setup program, setup.exe, will run. Setup will guide you through the installation process. By default, the Cost Model program is installed in a folder called "CEMS" on your hard drive. Activate the Cost Model by running the file called "costest.exe."

2.2 System Requirements

IBM or compatible computer with a hard disk

Windows 3.1, 3.11, 95, NT

Uses 8 MB of RAM

Designed to operate on monitors with resolution of at least 640 x 480. If your system has a monitor with higher resolution, the windows will use only a portion of the screen.

3.0 GENERAL DESCRIPTION OF COST MODEL

The CEMS Cost Model is designed to calculate default costs for the two basic types of CEMS designs (i.e., in-situ and extractive) located at either new or existing facilities. In addition, two types of extractive CEMS are modeled: one that uses separate monitors for each gaseous pollutant and one that uses an FTIR analyzer for all the gaseous pollutants. The model estimates costs for all of the tasks associated with a CEMS program (i.e., purchase, installation, operation, and reporting) to comply with regulations under 40 CFR Part 60, under which the CEMS is used to demonstrate continual compliance with an emission limit. The costing methodology is based on default values for cost factors and labor effort for each of the tasks. These default values are used to estimate costs for a "base case" CEMS. Linear multipliers adjust the default values to estimate costs for non-base case CEMS. Users can make a number of changes to tailor the costs to site-specific applications.

The remainder of this section is divided into 3 subsections. Section 3.1 describes the design of CEMS monitors and associated equipment for which the costs are estimated. Section 3.2 describes the costing methodology, including default variables and procedures for substituting site-specific values. Section 3.3 identifies assumptions used in the model.

3.1 Design of CEMS Equipment

The CEMS Cost Model estimates costs for a CEMS to monitor gaseous compounds, particulate matter, opacity, and exhaust gas flow rate. The remainder of this section describes the design of the monitors, data acquisition system, and sampling system. This section also describes the type of facilities at which the monitors may be installed and the type of quality assurance requirements that must be satisfied.

3.1.1 CEMS for Gaseous Compounds

CEMS for gaseous compounds are divided into three types: extractive, in-situ, and FTIR.

3.1.1.1 Extractive CEMS. Extractive CEMS are defined as systems that extract a gas sample from the exhaust at a measurement site and transport the sample through a conditioning system and into separate analyzers. Each analyzer measures its designated pollutant gas concentration. The Cost Model assumes that the analyzers are located in an environmentally controlled shelter. The Cost Model estimates costs for extractive CEMS to monitor for emissions of SO_2, NO_x, CO, THC, HCl, CO_2, and O_2.

3.1.1.2 In-situ CEMS. In-situ CEMS are defined as systems that allow the effluent gas to enter a measurement cell inserted in the stack or duct. The concentration of the pollutant in the effluent is then measured by a variety of techniques. Many in-situ instruments measure more than one pollutant. The model includes multi-component in-situ monitors for CO/CO_2, SO_2/NO_x, and $SO_2/NO_x/O_2$. Individual component monitors are included for SO_2, CO, and O_2. Since the in-situ analyzers are physically mounted on the stack, no shelter is included for an in-situ CEMS.

3.1.1.3 FTIR CEMS. The FTIR CEMS is basically the same design as the extractive CEMS except that all pollutant gas concentrations are measured with a single instrument. This model assumes the FTIR uses a hot/wet sample cell; therefore, a moisture removal device is not needed. As with the extractive CEMS, the FTIR instrument is housed in a shelter. Note, this model is designed to calculate a CEMS costs using an FTIR instrument to monitor for six gaseous compounds, specifically SO_2, NO_x, CO, HCl, CO_2, and O_2. Since an FTIR instrument is capable of measuring many other pollutants (e.g., HAP's), the estimated cost to monitor any combination of the six compounds listed in the model would also represent the cost to monitor the same number of other compounds. However, the estimate may be slightly less accurate because the cost for certain items, like calibration gases, could be different for HAP's.

3.1.2 Opacity Monitor

The opacity of particulate matter in stack emissions is measured based upon the principle of transmissometry. Light, having specific spectral characteristics, is projected from a source through the effluent in the stack or duct, and the intensity of the projected light is measured by a sensor. The projected light is attenuated because of absorption and scatter by the particulate

matter in the effluent; the percentage of visible light energy attenuated is defined as the opacity of the emission. The opacity monitor used to determine the opacity of the effluent consists of a transmissometer, from which the in-situ opacity is determined, and all other interface and peripheral equipment necessary for continuous operation. The opacity monitor includes sample interface equipment such as filters and purge air blowers, shutters or other devices may be included to provide protection during power outages or failure of the sample interface, and a remote control unit to facilitate monitoring the output of the instrument, initiation of zero and upscale calibration checks, or control of other monitor functions. The cost for the Manufacturer's Certificate of Conformance (MCOC) is also included.

3.1.3 PM Monitor

Particulate (PM) monitors that measure particulate concentration (mg/m^3) are in the early stages of use in this country but have been used extensively in Europe. The EPA's Office of Solid Waste (OSW) completed an evaluation in 1997 of several types of PM monitors to determine if these monitors could be used for monitoring compliance with a PM standard. The devices that were evaluated by the OSW as PM monitors included:

- time dependent optical attenuation,
- light scattering (forward, backward, and 90^o),
- beta gauge,
- tribo electric, and
- acoustic energy.

The cost model assumes the design and performance of the PM monitor conforms to draft Performance Specification 11 (PS-11) that was proposed in 1996. PM monitor equipment cost used in the model was the average purchase price of three light scattering devices and two beta gauge devices (the monitors used in the last OSW field evaluation). Labor related activities were based on light scattering devices because those devices produced results for all of the test periods of the OSW study and functioned reliably (i.e., light scattering devices were perceived as the most promising technology at the time).

The cost model does not include all the ancillary equipment necessary for a PM monitor to meet the requirements of the proposed, revised regulations for hazardous waste combustion sources. Those regulations require that PM monitor data be converted into units of the standard (mg/dscm @ 7% O_2). To convert the PM monitor data to units of the standard, the facility will need to know exhaust gas oxygen, temperature, pressure, and moisture. The model can be used to estimate the cost for monitoring O_2, but the model does not incorporate methodology to estimate costs of sensors or monitors for the other parameters.

3.1.4 DAS

The data acquisition system (DAS) consists of the hardware (computer, monitor, and printer) and software to interface with the monitoring system and provides reports, data storage, and screen displays. The software is multi-tasking, allowing several programs to run simultaneously. Some example DAS computer program functions are the following:

- allow the operator to interface with the CEMS (e.g., check alarms, change calibration gas values, reset calibration intervals, and review analog and digital data from the monitors),
- print hard copies of logs and reports, and
- average data, calculate emissions, and create reports.

The cost model does not account for customer specific DAS requirements such as networking CEMS data to other terminals or generating customer specific reports. Also, an uninteruptable power supply (UPS) is not included. These features may be desirable and many users may elect to include in their CEMS, but they are not necessary to comply with the regulations. Programmable logic controllers (PLCs) to interface between the analyzers and DAS are included in the sampling system.

3.1.5 Sampling Systems

The extractive CEMS sampling system consists of a heated sampling probe and filter, heated sample transport tubing, sample conditioning system, sample pump, additional sample tubing and

valving, and calibration gas equipment. Also included in the cost of the sampling system is the PLC interface between the monitors and DAS, vendor assistance to install the equipment, and initial technician training. The model assumes the sampling system for a sampling location before the control equipment is more expensive than the sampling system for a sampling location after the control equipment. The greater cost is assumed to be due to the longer heated sample transport tubing and higher temperatures and particulate loadings that likely would require more expensive probe material and filtering techniques. The extractive FTIR CEMS sampling system consists of the same components with the exception of the sample conditioning system.

The in-situ CEMS sampling system consists of calibration gas equipment and tubing.

3.1.6 Type of Facility

The Cost Model is designed to estimate costs for CEMS at either an existing facility or a new facility. The cost for installing the CEMS on a source at an existing facility is higher than for a new facility because of site modifications typically needed at an existing facility. For example, costs for certain planning activities, providing utilities, and installation are higher for existing facilities. Also, the model can accommodate the additional monitoring needed for a facility that must calculate removal efficiency of a control device by adding analyzers before the control device. The default sampling location is after the control system, even for sources without control equipment.

3.1.7 QA Requirements

The Cost Model determines the cost for a CEMS intended to meet 40 CFR Part 60 performance specification and quality assurance requirements. The model's assumed labor estimates for performance testing and QA evaluations are applicable to Part 60 procedures (i.e., Appendices B and F). The Cost Model specifically does not include the additional testing and QA requirements for a 40 CFR Part 75 CEMS. Therefore, this model will not provide an accurate estimate for a Part 75 CEMS unless the user can make the appropriate corrections.

3.2 Costing Methodology

3.2.1 General

This cost model is designed to provide the first costs and annual costs for a single CEMS installed to monitor emissions from one source at a facility. It does not allow the user to estimate costs for multiple CEMS to monitor multiple sources at a facility; the user also should not multiply the model's result by the number of CEMS because this will overestimate the cost. The first costs and annual costs are grouped by tasks as listed in Table 3-1. In the model, each task is subdivided into subtask activities. Subtask activities are detailed in Appendices A, B, and C.

TABLE 3-1. COST MODEL TASKS

Capital Cost Tasks	Annual Cost Tasks
Planning	Daily Activities
Selecting Equipment	Annual RATA
Support Facilities	CGA (or equivalent)
Purchase CEMS	Recordkeeping & Reporting
Installation	Annual QA & O&M Review and Update
Performance Spec. Tests	
QA Plan	

3.2.2 Base Case CEMS

The Cost Model uses a “base case” CEMS as the reference point to calculate the default cost of the CEMS. The base case CEMS monitors for the following pollutants after any installed pollution control equipment:

SO_2, NO_x, CO, diluent, and opacity.

However, the Cost Model estimates the same cost for any CEMS of a particular type consisting of monitors after control for four gaseous compounds and one monitor after control for either opacity, PM, or flow. The after control option also provides the correct costs for a CEMS at a source that does not have control equipment. The base case CEMS designs for the three types of monitoring systems (in-situ, extractive, and FTIR) are presented in Table 3-2.

TABLE 3-2. BASE CASE CEMS DESIGN

Type of CEMS	Number of Pollutant Gas Analyzers	Number of Opacity, PM, Flow Monitors
In-Situ	2	1
Extractive	4	1
FTIR	1	1

3.2.3 Default Unit Costs and Cost Factors

The model includes default values for equipment unit costs, personnel cost factors, and various other direct costs. All of these values can be modified by the user to fit a specific situation. The model also includes options to include or exclude certain subtasks (e.g., best and final meeting and platform/ladder) that may not be needed at all facilities.

3.2.3.1 Equipment Unit Costs. The cost of hardware used in the model is the average of the cost for several vendors' equipment. The default costs of the CEMS hardware used in the Cost Model are presented in Table 3-3. The default unit costs for extractive CEMS analyzers, PM monitors, and flow monitors were based on the average costs for the equipment listed in Table 3-4. The default costs for opacity monitors and data acquisition systems were based on information from CiSCO and Monitor Labs. The default costs for the in-situ analyzers are based solely on price estimates received from Monitor Labs. The default cost estimate for the FTIR analyzer was obtained from Analect Instruments.

TABLE 3-3. DEFAULT EQUIPMENT UNIT COSTS

Equipment	Cost, $		
	Extractive	**In-situ**	**FTIR**
Sampling system			
- After control	40,000	1,000	37,800
- Before control	50,000	2,000	47,800
Data acquisition system	20,000	20,000	16,000[a]
CEMS shelter	12,000	N/A	10,000
Fabrication of system in shelter	12,800	N/A	7,700
Monitor control unit	N/A	10,000	N/A
FTIR analyzer	N/A	N/A	100,000[b]
Gaseous compound analyzers			
- NO_x	10,440	N/A	N/A
- SO_2	12,500	35,000	N/A
- CO	8,490	28,000	N/A
- CO_2	7,890	N/A	N/A
- O_2	5,860	6,600	N/A
- THC	10,200	N/A	N/A
- HCl	12,390	N/A	N/A
- SO_2/NO_x	N/A	37,000	N/A
- $SO_2/NO_x/O_2$	N/A	45,000	N/A
- CO/CO_2	N/A	34,000	N/A
Monitors[c]			
- Opacity	25,000	25,000	25,000
- PM	37,700	37,700	37,700
- Flow	18,000	18,000	18,000

[a]Only needed if system includes opacity or PM monitor.
[b]Add $8,000 for capability to monitor before control as well as after control.
[c]All CEMS use identical opacity, PM, and flow monitors.

TABLE 3-4. VENDOR EQUIPMENT USED TO DEVELOP DEFAULT EQUIPMENT COSTS

SO_2 Analyzers	**NO_x Analyzers**	**CO Analyzers**	**O_2 Analyzers**	**CO_2 Analyzers**	**THC Analyzers**	**PM Monitor**	**Flow Monitor**
ML 9850	ML 9841 A/AF	ML 9830/32	LS 422	ML 9820	JUM VE7	ESA Beta 5M	USI Ultraflow 100
TEI 43 CHL	TEI 42CH	TEI 48C	Servomex 1440	TEI 41CH	TEI 51	Durag DR300	Kurz 4500 4-point & 8-point
Rosemount 9100	Rosemount 951C	Rosemount 880A	Rosemount OXA 1000	Servomex 1440	MSA 8800	Verewa F904KD	EMRC pitot tube
Western Research 712 ATM	California Analytical 300 CLD	California Analytical ZRH	California Analytical 100	California Analytical ZRH	California Analytical 300HFID	ESC P5A	Detric pitot tube
		Siemens Ultramat 22	Siemens Oxymat 5	Siemens Ultramat 22	Eagle EM7000	Sigrist KTNR	

3.2.3.2 Personnel Cost Factors. Several "cost factors" are used throughout the model. The cost factors apply to each of the individuals (corporate environmental engineer, plant technician, plant technician II, CEMS consultant, and test personnel) who perform activities associated with the tasks that are performed while implementing the CEM program. The default cost factors used in the Cost Model are presented in Table 3-5.

TABLE 3-5. PERSONNEL COST FACTORS

	CEE	**Plant Technician**	**Plant Technician II**	**CEMS Consultant**	**Test Personnel**
Wage rate, $/hr w/o OH	30.00	18.00	27.00	27.00	16.00
Overhead (OH), % of wage rate	40	40	40	200	200
Travel time to facility, h/trip	6	NA	NA	12	12
Travel fare to facility, $/trip	200.00	NA	NA	600.00	50.00
Per diem, $/day	100.00	NA	NA	125.00	75.00
Fee, % profit	NA	NA	NA	10	10

The corporate environmental engineer (CEE) rate and plant technician rate were confirmed with two electric utilities, an independent power producer (IPP) company, and a pulp and paper company. The labor rate for the CEMS consultant and test personnel is based on current market values. The default overhead (OH) for the CEE and plant technician is the average OH for an electric utility company, an IPP, and a pulp and paper company. The OH of 200 percent for the CEMS consultant and test personnel labor may be somewhat conservative (high), especially with the recent attempt by environmental firms to reduce costs. The plant technician II is used only for FTIR systems, which require a higher level of expertise to operate.

The CEE's travel time to the facility and back is set at 6 hours. This represents time spent driving a car from corporate headquarters to the facility and back. In the CEE's ODCs, a fare of

$200 (for car rental) is associated with each trip to the plant. The CEMS consultant's travel time to the facility and back is set at 12 hours. A cost of $600 (for airfare) is associated with the consultant's trip to the plant. The test contractor personnel travel time to the facility and back is set at 12 hours. The cost model assumes that all test personnel travel with the equipment to the facility, and that the facility is about 6 hours drive time from the test contractor's office. The travel fare for the test contractor personnel is set at $50 per person per trip to cover fuel costs.

3.2.3.3 Other Direct Costs for Vendor Services. Equipment startup and resolution of problems after startup are two specific field activities that are conducted by the CEMS vendor with assistance from plant technicians. In the Cost Model, these two vendor services are included as other direct costs (ODCs). The vendor service's ODC for equipment startup is divided into the following three costs: travel labor and airfare, field labor and expenses for the gas pollutant monitors, and field labor for the opacity, flow, or PM monitors. The vendor service's ODC for problem resolution is divided into field labor and expenses for the gas pollutant monitors, and field labor for the opacity, flow, or PM monitors. These two ODCs can be modified by the model user to fit a specific situation.

For startup of a base case extractive CEMS, the labor assumptions are (1) two vendor technicians work three days on the gas pollutant monitors and (2) two vendor technicians work ½ day on an opacity, flow, or PM monitor. For problem resolution of a base case extractive CEMS, the labor assumptions are (1) two vendor technicians work one day on the gas pollutant monitors and (2) two vendor technicians work two hours on an opacity, flow, or PM monitor.

For startup of a base case extractive FTIR CEMS, the labor assumptions are (1) one vendor technician works three days on the FTIR instrument and (2) one vendor technician works one day on an opacity, flow, or PM monitor. For problem resolution of a base case extractive FTIR CEMS, the labor assumptions are (1) one vendor technician works 1½ days on the FTIR instrument and (2) one vendor technician works four hours on an opacity, flow, or PM monitor.

For startup of a base case in-situ CEMS, the labor assumptions are (1) two vendor technicians work 1½ days on the gas pollutant monitors and (2) two vendor technicians work ½

day on an opacity, flow, or PM monitor. For problem resolution of a base case in-situ CEMS, the labor assumptions are (1) two vendor technicians work ½ day on the gas pollutant monitors and (2) two vendor technicians work two hours on an opacity, flow, or PM monitor.

3.2.3.4 Task Options. The model includes default positions for the following four tasks that the user may choose to modify for a given CEMS analysis:

- Best and final meeting
- Functional acceptance test (FAT)
- Platform and ladder for the standard CEMS
- Platform and ladder specific for the PM monitor.

3.2.3.4.1 Best and Final Meeting Option. The best and final meeting is a time when the purchaser of the CEMS interviews the two vendors that submitted the "best" proposals. The best and final meeting is also a time for the vendor to make a verbal sales presentation. Based on the results of these meetings, the purchaser will determine which vendor they think will work to their satisfaction. It is recommended that the cost for the best and final meeting be included because, based on experience, the results of the best and final meeting always weigh heavily on the final decision of which vendor to choose.

3.2.3.4.2 Functional Acceptance Test Option. The FAT is a shop test of the CEMS, conducted at the vendor's facility before the system is shipped to the source facility. At the FAT, the purchaser witnesses a test program that is designed to determine if the CEMS is functioning properly and meeting the performance specification. Problems that are found at the FAT are fixed before the system leaves the vendor's shop. If the FAT is not conducted and problems are found during startup of the CEMS, the purchaser will incur additional costs and delays for repairing the system in the field. It is recommended that the cost for the FAT be included.

3.2.3.4.3 Platform and Ladder Options. The cost for a platform and ladder is not included in the Cost Model's default conditions for a gaseous pollutant CEMS. All source emission points that are subject to emission regulations are required to have a platform and ladder for source testing purposes. This would include almost all new sources. However, many existing sources that were not subject to emission regulations in the past are now becoming regulated, and a platform and ladder may be need. Therefore, the model includes a cost for a platform and ladder which the user can select to include in the CEMS cost.

In addition to a platform and ladder for the gaseous pollutant CEMS, the model's default condition includes the cost of a platform and ladder specifically for a PM monitor. In many possible monitoring situations, the location of an existing sampling platform that is suitable for the gaseous pollutant probe (and source testing purposes) will not be satisfactory for PM or opacity monitoring. The user can elect to not include the cost of a platform and ladder for the PM monitor if the existing platform will allow the PM monitor to be located at an acceptable sampling site.

3.2.4 Default Labor Estimates

For each subtask activity, a labor estimate for the individuals performing the activity is used to calculate the activity's cost. Also, if other direct costs (ODCs) are incurred by the facility while performing the activity, an estimate for the ODC is included. The estimates for labor, travel, and materials and supplies (i.e., ODCs) used in this model are based on years of experience in the field of continuous emission monitoring and input from CEMS vendors and users. As with any estimate, the default conditions that are used to calculate the estimate will vary from case-to-case. Therefore, the user can, and should, make adjustments to suit each specific situation.

3.2.5 Fudge Factors

The model uses linear adjustment "fudge factors" to reduce or increase labor effort (i.e., cost) if the user selects a CEMS that is different from the base case CEMS. The fudge factor adjustments are based on the model developer's knowledge and experience in the field of continuous emission monitoring. The user is **not** able to make adjustments to the fudge factors. However, the user can modify the calculated default costs for individual subtasks if the calculated value is not applicable to a specific source. The labor estimates (for a base case CEMS) for each subtask activity conducted in the CEMS program are presented in Appendices A, B, and C.

3.3 Assumptions

In addition to the cost variables and cost factors noted above, many other assumptions regarding CEMS procurement, installation, operation and maintenance, and other activities are

made in this Cost Model. These assumptions are based on CEMS vendor input, CEMS user input, and the model developer's experience in the field of CEMS. Listed below are many of the assumptions that were incorporated in the costing methodology.

3.3.1 Labor Related Assumptions

1. The estimated labor for reviewing vendor proposals for an in-situ CEMS is lower than for an extractive CEMS. This is because there are fewer vendors that offer in-situ CEMS than extractive CEMS, and the CEE will have fewer in-situ CEMS proposals to evaluate.

2. A best and final meeting with the two best vendors is included in the Review and Evaluate Proposals subtask. The best and final meeting is held during one day at the source facility (i.e., one vendor is interviewed in the morning and the second vendor is interviewed in the afternoon). Since the results of the best and final meeting always weigh heavily on the final decision of which vendor to choose, the cost is automatically included. The user has the option to not include the cost for a best and final meeting in the *Set Variables - Options* section of the Cost Model.

3. The cost of conducting a functional acceptance test (FAT) is included in the extractive and FTIR modules. The FAT is a shop test (to determine if the CEMS is functioning properly and meeting the performance specification) of the CEMS that is conducted at the CEMS vendor's facility before the system is shipped to the source facility. The FAT is attended by the CEE and one technician. The user has the option to not include the cost for a FAT in the *Set Variables - Options* section of the Cost Model.

4. The extractive CEMS model and the FTIR model include vendor cost for CEMS fabrication at the vendor's shop. The base case CEMS cost estimate is based on 320 labor hours for an extractive CEMS and 190 hours for an FTIR CEMS at $40 per hour.

5. The pretest meeting with the testing contractor and regulatory agency is conducted the day before the actual RATA.

6. The cost of the gas analyzer RATA is calculated using a two-person test crew. If a flow monitor is included with the gas analyzers, the cost is calculated using a three-person test crew.

7. The in-situ gas analyzers' routine maintenance checks are performed daily, monthly, and quarterly. Routine maintenance checks of the extractive CEMS gas analyzers and FTIR analyzer are performed daily, weekly, and monthly. Routine maintenance checks of the opacity monitor are performed daily and quarterly.

8. The model assumes that the CEE does not attend the annual CEMS RATA.

9. The annual cost of corrective action and a retest associated with a CEMS that is failing its RATA is multiplied by 0.35. This is done to reduce the life cycle cost since corrective action and a retest is only expected to be needed in 3 to 4 out of 10 RATAs.

10. The annual cost for training is multiplied by 0.33. This is done to reduce the life cycle cost of training since training is assumed to occur every third year.

11. The model assumes the following CEMS training for the base case CEMS:

- For an in-situ CEMS
  1-day of DAS training
  2 days of analyzer training
- For an extractive CEMS
  1-day of DAS training
  3 days of analyzer/system training.
- For an FTIR CEMS
  1-day of DAS training for opacity, PM, and flow
  10 hours for two technicians
  20 hours for two FTIR technicians (Tech IIs).

Training is conducted by the CEMS vendor at the source facility.

3.3.2 Equipment Related Assumptions

1. The cost of a platform and ladder is not included in the gaseous pollutant monitor default conditions of the model. The model developers did not believe that the CEMS should bear the cost of a platform and ladder. If a platform and ladder are needed, the user is able to include this cost ($4,000). However, the cost of a platform and ladder is included as a default condition for a PM monitor.

2. The model assumes that a flow monitor will need two ports. If the stack is large (e.g., 10 feet in diameter), the flow monitor may need four ports. If the flow monitor is expected to require four ports, then the user should simply double the cost of sample ports.

3. The cost of a shelter for the CEMS is not included in the in-situ CEMS cost. Since in-situ monitors are mounted on the stack, a shelter is not necessary.

4. If the CEMS is only an opacity monitor, the opacity data is recorded by a DAS in electronic format. If the user wants to use only a strip chart recorder to record opacity monitor data, the DAS cost would be much lower, but the daily data reduction and monthly data reduction would greatly increase. Also, the user is instructed to cost an opacity only CEMS by selecting an extractive type CEMS.

5. The sampling system cost is limited to only one sampling line after the control equipment and one sampling line before control equipment. Also, the sampling line does not include spare lines.

6. For a source that does not employ control equipment, the user should select the monitoring location “after control equipment.” If the user selects the monitoring location “before control equipment,” the model will not calculate the correct cost.

7. The annual cost of replacement parts is assumed to be the following:

- 5 percent of the in-situ analyzer(s) cost

- 10 percent of the extractive analyzer(s) cost
- 5 percent of the opacity, PM, and flow monitor cost
- $20,000 for the FTIR system.

3.3.3 CEMS Design Features and Activities not Covered by the CEMS Model

To keep the model manageable, it cannot accomodate every conceivable design feature, construction detail, or operational activity. Some alternative situations that can not be accomodated are described below. If the user is knowledgeable of the increases or decreases in cost created by a specific situation, the user can make the appropriate adjustments to the calculated cost summary.

1. If the CEMS is part of a General Contractors (GC) construction bid, this Cost Model will likely not provide the same initial capital cost for a CEMS that is quoted by the GC. Many of the activities included in the model (and thereby the associated costs) may not be performed by the GC or the CEE. For example, the following list of activities that are normally performed by the CEE will likely not be performed by the GC or CEE if a GC is tasked with providing the CEMS: copying and mailing RFPs, responding to bidders questions, reviewing vendor proposals, selecting a vendor, and negotiating a contract. Therefore these costs probably will not be included in the GC's CEMS cost.

2. The cost of support facilities (i.e., ports and utilities) is dependent on site specific conditions. For instance, the following conditions will have an affect on the cost of support facilities:

- Type of stack - brick, steel, fiberglass, lined or unlined,
- Location of stack - free standing or through a building roof,
- Height and diameter of stack,
- Distance to nearest, useable electrical panel box and plant air supply - will affect the amount of conduit and piping needed,
- Facility safety requirements - e.g., explosion proof areas, and

- Existing platform and ladder.

The model does not include any of the above variables to adjust the cost of the model.

3. The model does not include the cost for backup monitoring systems. Also, the model does not include the cost for ancillary equipment such as new fuel flow meters that may be needed in some CEM applications.

4. The model does not adequately handle the cost of day-to-day activities for a flow monitor. The model clearly addresses gas analyzers and opacity monitors, but it does not specifically address flow monitors in the day-to-day activities task. Since a flow monitor comes under the opacity monitor category in the model's cost calculations, the day-to-day activity costs for a flow monitor are handled under the COMS day-to-day activities. Since actual day-to-day activities for a flow monitor are different than for an opacity monitor, the model likely underestimates the true costs for day-to-day activities for a flow monitor.

5. The extractive CEMS cost calculated by this model is for a full-scale, rack-mounted type analyzer CEMS. Several CEMS vendors are now offering a "low-cost" CEMS that is becoming applicable to more and more situations. This model will overestimate the cost of a "low-cost" CEMS.

6. If the CEMS is reporting pollutant emissions on a mass emission basis (i.e., lb/hr), the model only includes a stack flow monitor for measuring exhaust gas flow rate. However, in some applications, other techniques can be used to determine exhaust gas flow rate.

7. The Cost Model does not allow the user to mix in-situ and extractive type monitors to construct a CEMS.

4.0 INFORMATION ABOUT USING THE CEMS COST MODEL

4.1 Summary Procedure

Procedure for Use

1. Open the CEMS Cost Model by choosing: Start/Programs/CEMS Cost Model/CEMS.
   At the introduction screen, click the Continue button.
2. At the Main Menu, click on: Variables. At the pull-down menu, choose: Set Variables.
3. At the Set Variables screen:
   A. Choose the radio button that represents your choice of gas pollutant monitor.
   B. Choose each of the four tabs and make all appropriate changes.
      If you enter a character other than a number, the Model registers it as a zero.
   C. Click on: OK.
4. At the Main Menu, click on: Device; then choose: CEMS Design.
5. At the Select CEMS Design Features screen:
   A. Use the radio buttons to choose your Gas Pollutant Monitor Type and Plant Type.
   B. Use the arrows to select Sampling Location and Monitor.
   C. Click the Add button to enter the monitor in the window.
   D. Repeat steps B and C for each monitor.
      You can select a device and press the Delete key to remove it from the list.
      Note that the Sampling Lines fields will reflect your choices.
      If you have chosen a Before location, you must also choose an After location.
      If not, you will see the warning 'Invalid configuration.' Until you correct this problem, you will not be able to use the OK button to start calculations.
   E. Click on: OK. The Model will run your cost estimations.

6. At the Main Menu, click on: Costs.
   A. You can choose to view Totals, Subtasks, and Configuration.

      To print Totals or Subtasks costs or system configuration, click on: File; at the pull-down menu, choose the appropriate print option.
   B. On the Subtasks screen, you can change specific entries. When you press Enter, the costs are revised. The totals for any changed fields will appear in red on the Totals screen.
   C. You can cancel your changed fields by:

      Click on: Actions; at the pull-down menu, choose: Reset to calculated values.
   D. You can export the cost information on each screen by:

      Click on: Actions; then at the pull-down menu, choose: Export.

      You will see the 'Export data to Excel' screen, on which you can establish a file name and file path and save the data.
   E. Click on: File; at the pull-down menu, choose: Return to Main Menu.
7. At the Main Menu, you can:
   A. Open and save data files by:

      Click on: File; at the pull-down menu, choose the option you want.
   B. Clear current CEMS selections by:

      Click on: File; at the pull-down menu, choose: New
   C. Return the cost variables to the default values by:

      Click on: Variables; at the pull-down menu, choose: Reset to default.
   D. Run another set of calculations by:

      Decide whether to clear current CEMS selections (Step 7B).

      Decide whether to return variables to the default (Step 7C).

      Continue the procedure beginning at Step 2.
   E. Exit the program by:

      Click on: Exit.

4.2 Detailed Procedures

This section describes the procedures to define the CEMS for which costs are to be estimated. This section also shows the results of the analysis for an example CEMS and how to make changes for a site-specific analysis.

4.2.1 CEMS Cost Model Initial Menu Screen

The cost model starts with the menu screen shown in Figure 4-1. The five pull-down menus are described in the subsections below. The first time the model is used, a message box giving a brief description of the function of each menu is displayed.

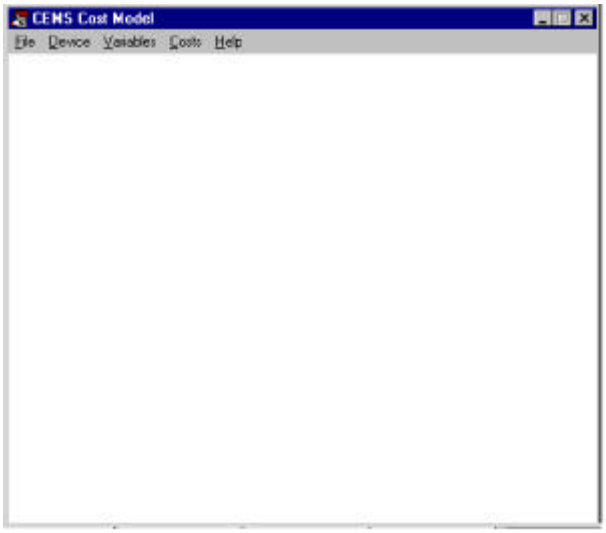

Figure 4-1. Initial Menu Screen.

4.2.2 File Menu

The File menu contains standard Windows file management commands to open files, save files, and exit the program. The New command clears current CEMS sections. By default the model saves files with a .SAV extension, but any other extension may be used.

4.2.3 Device Menu

Clicking on Device and choosing CEMS Design brings up the screen shown in Figure 4-2a. On the screen, you select the components and features of the CEMS for which costs are to be estimated.

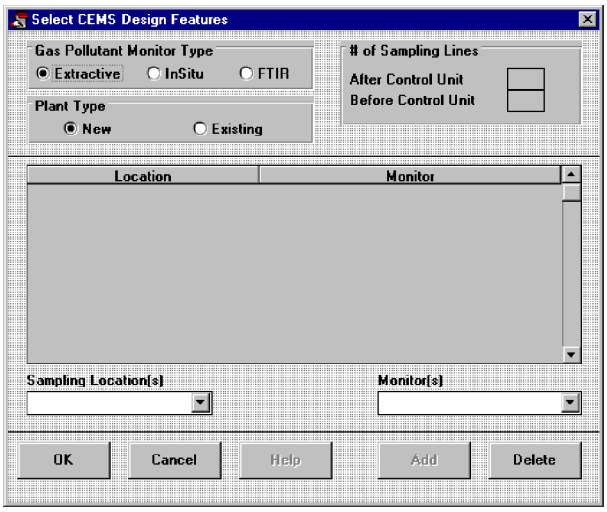

Figure 4-2a. Blank CEMS design screen.

Use the radio buttons at the top left to choose Gas Pollutant Monitor Type and Plant Type. Then move below the large, center window to the Sampling Location and Monitor options. Use the pull-down menus to select each monitor and its location, and click Add. This action places that monitor in the center window. You can continue this list to reflect all the monitors at the site, but you cannot add duplicate monitors. To delete a monitor from the list, select it in the center window and then click on the Delete button. Click OK when the CEMS design is complete. Figure 4-2b shows the screen for a base case CEMS at an existing plant.

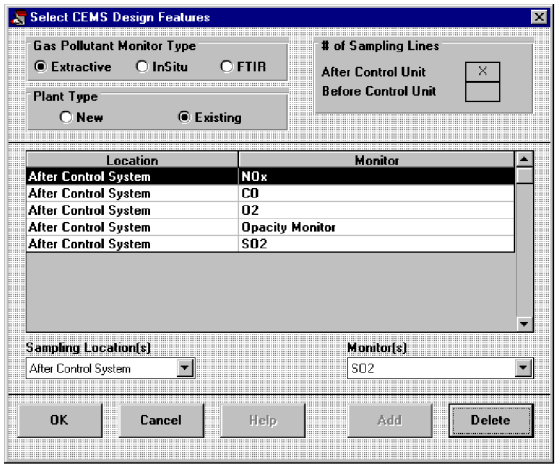

Figure 4-2b. Completed CEMS design screen for base case CEMS.

If you have chosen a Before Control System location for a particular type of monitor, you must also choose the same type of monitor at the After Control System location. If not, you will see the following warning when you click OK.

You must correct the configuration by adding the same type of monitor at the after control system location or by deleting the monitor from the Before Control System location. Until you do so the Cost Model will continue to display the invalid configuration warning. You can select a device on the window and click on the Delete button to remove it from the list.

Switching the monitor type or plant type will clear any selected monitors.

The sampling lines box is not for input information; it simply reflects other choices. When a monitor for a gaseous compound is selected, an "X" appears in the appropriate box. The "X" signifies that the model estimates costs for a single sampling system at that location. To estimate costs for more than one sampling system, you need to either change the default unit cost for the sampling system or change the subtask cost for the sampling system.

When you click OK, the Cost Model will calculate your cost estimations and return to the main menu.

4.2.4 Variables Menu

The Variables menu contains two options: Set Variables and Reset to Default. Selecting Set Variables provides access to a set of screens that displays the user definable, default cost information used in the calculations. For each of the three types of CEMS monitors (in-situ, extractive, and FTIR), the cost information is grouped under four tabs: CEMS, Employee,

Vendor Services, and Options. The CEMS tab includes the costs of the CEMS equipment. The Employee tab includes the wage rates and other cost factors for each type of personnel involved in the CEMS program. The Vendor Services tab includes ODC's for startup and problem resolution activities performed by the CEMS vendor. The Options tab allows you to select costs for the activities described in section 3.2.3.4 of this manual. One item under the Options tab allows you to select whether to have the model calculate capital recovery costs and shows the default capital recovery factor. Figures 4-3a through 4-3d show the information under each tab for the extractive CEMS. Similar information is contained under the tabs for In-situ CEMS and FTIR systems.

You can customize these values, i.e, change costs that you know will be different for a specific application, or you can select or deselect options. The Cost Model will pull the information it needs from these lists.

The fields are for numbers only. If you enter letters or other characters, the Cost Model will translate these to zero.

You do not have to have the necessary information visible on the screen, and you do not have to change information that the Cost Model will not be using. For instance, only one category of employee is visible at a time, but the costs for all types of employees will be used. Also, although you may monitor for only one pollutant, the cost fields for the other monitors do not need to be set to zero.

The values are entered when you click OK. They will stay until you change each individually or choose the 'Reset to default' option. It is very easy to fail to correct specific changes in the variables. Therefore, it is a good idea to choose the 'Reset to default' option each time you start a new calculation.

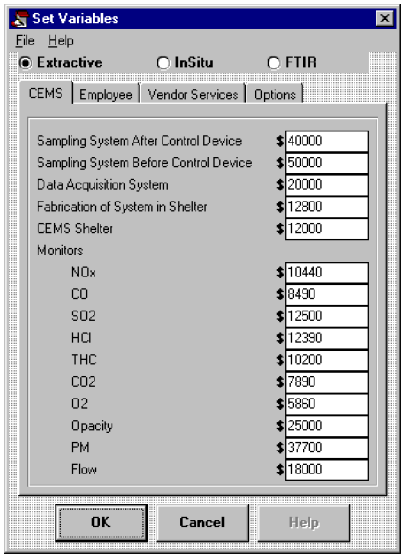

Figure 4-3a. Default Unit Costs for CEMS Equipment.

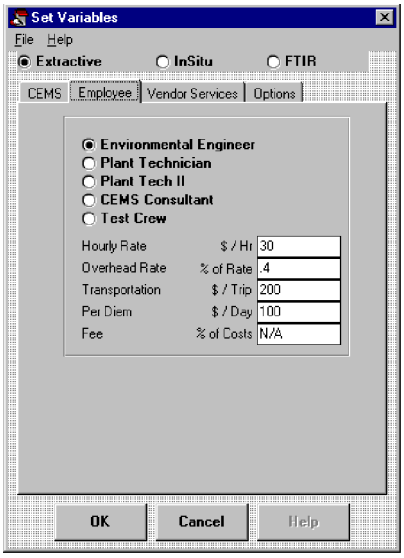

Figure 4-3b. Default Personnel Cost Factors.

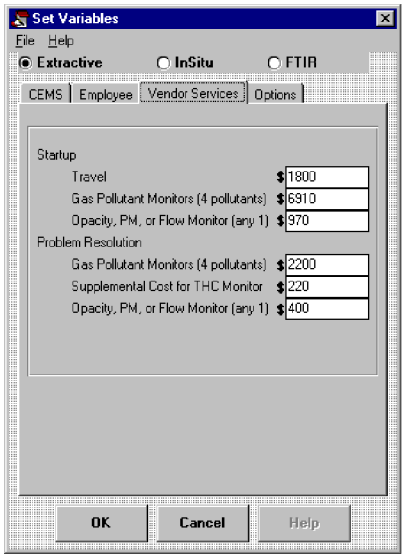

Figure 4-3c. Default ODC's for Vendor Services.

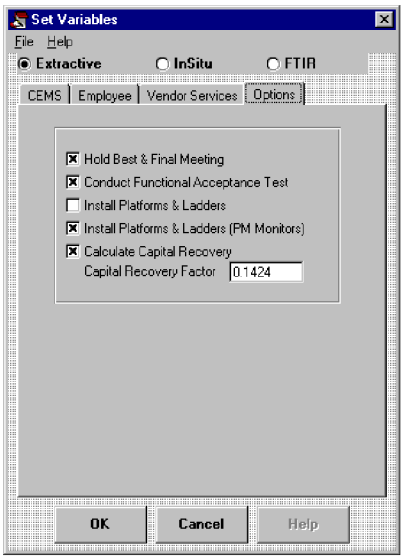

Figure 4-3d. Default Options.

Selecting Help from the menu bar provides information about many of the terms used in the Variables screens. Selecting File from the menu bar allows you to print the default variables or to return to the main menu.

When you click OK, you are returned to the main menu.

4.2.5 Costs Menu

The costs menu contains options to view, modify, and print estimated costs. The costs also can be exported to an Excel spreadsheet.

The Costs menu contains three tabs: Totals, Subtasks, and Configuration. The Totals tab allows you to view the estimated first costs and annual costs for the selected CEMS. The Subtasks tab allows you to view the costs for each of the activities under the main tasks. Figure 4-4 shows the table of totals costs for the example base case CEMS; Figure 4-5 shows part of the table of subtask costs.

You can also change any of the subtask costs. To change a subtask cost, select the appropriate cell, type in the new value, and press enter. This action will cause the value on the Totals table to change and appear in red, signifying a change. For example, suppose the facility always uses the same test contractor. Therefore, the CEE does not need to spend 16 hours selecting the test contractor for the performance specification test (see Appendix A for the 16 hours). The corporate and facility labor costs of $756 and the other direct costs of $50 can be replaced with zeros in item VI.A. of the subtask costs table. The total cost for the performance specification test drops from $10,200 to $9,400.

You can cancel your changes by clicking Actions and then choosing ‘Reset to calculated values’ at the pull-down menu. You can export the estimated costs to an Excel spreadsheet by clicking Actions, choosing ‘Export’ at the pull-down menu, and establishing a file name and file path. You can print particular information by selecting File from the menu bar and then selecting the appropriate print option.

Costs

File View Actions

Totals | Subtasks | Configuration

Task	Corporate and facility labor costs	Consultant and test team costs	Other direct costs	Total Costs
Planning	$ 3,200	$ 0	$ 400	$ 3,600
Select Equipment	$ 13,700	$ 0	$ 2,000	$ 15,700
Provide support facilities	$ 0	$ 0	$ 14,600	$ 14,600
Purchase CEMS	$ 0	$ 0	$ 143,100	$ 143,100
Install & Check CEMS	$ 5,400	$ 0	$ 12,300	$ 17,700
Performance Spec Tests	$ 2,700	$ 6,700	$ 800	$ 10,200
Prepare QA/QC Plan	$ 3,000	$ 16,800	$ 800	$ 20,500
Total First Costs	**$28,100.00**	**$23,500.00**	**$173,800.00**	**$225,400.00**
Operation & Maintenance	$ 12,500	$ 0	$ 2,800	$ 15,200
Annual RATA	$ 900	$ 5,500	$ 0	$ 6,500
PM Monitor RCA	$ 0	$ 0	$ 0	$ 0
Quarterly CGAs	$ 1,800	$ 0	$ 1,700	$ 3,500
Record Keeping	$ 15,100	$ 0	$ 200	$ 15,300
Annual Review & Update	$ 3,500	$ 0	$ 6,900	$ 10,400
Capital Recovery				$ 32,100
Total Annual Costs	**$33,900.00**	**$5,500.00**	**$11,500.00**	**$50,900.00**

Note: Values may not add exactly due to rounding for display

Figure 4-4. Totals costs for base case CEMS.

Costs

File View Actions

Totals | Subtasks | Configuration

Task	Corporate and facility labor costs	Consultant and test team costs	Other direct costs	Total Costs
V. Install & Check CEMS				
A. Install CEMS	$3,830			$3,830
B. Start up equipment	$907		$9,680	$10,587
C. Resolve problems	$353		$2,600	$2,953
D. Calibrations	$328			$328
Total	$5,418	$0	$12,280	$17,698
VI. Performance Spec Tests				
A. Select test contractor	$756		$50	$806
B. Pretest meeting with ctr & agency	$605	$317	$300	$1,222
C. Drift tests per EPA specs	$706		$300	$1,006
D. CEMS PST	$437	$4,874	$100	$5,411
E. Write PST test report		$1,484		$1,484
F. Review report & send to agency	$244			$244
Total	$2,748	$6,675	$750	$10,173
VII. Prepare QA/QC Plan				
A. Review needs & requirements	$218			$218

Figure 4-5. Subtask costs for base case CEMS.

4.2.6 Help Menu

The Help menu provides information about the developers of the Cost model, including a point of contact at EPA.

Appendix A

In-situ CEMS Base Case Labor and ODC Estimates Per Activity

Activity	CEE	Plant Technician	Facility ODCs	CEMS Consultant	Test Personnel
Capital Costs					
Task 1 - Planning					
Review Regulations	6 hr - gaseous pollutants; 1 hr - monitor				
Resolve Questions	6 hr - travel; $200 fare; 1 day per diem; 4 hr - gaseous pollutants; 1 hr - monitor				
Review Drawings	10 hr				
Inspect Source	6 hr during site visit for Resolve Problems; 1 day per diem	4 hr			
Define Specific Constraints - New Source	8 hr - gas analyzers; 2 hr - monitor				
Define Specific Constraints - Existing Source	12 hr - gas analyzers; 4 hr - monitor				
Write Engineering Report - New Source	16 hr - gas analyzers; 2 hr - monitor				
Write Engineering Report - Existing Source	20 hr - gas analyzers; 4 hr - monitor				
Task 2 - Select Equipment					

Activity	CEE	Plant Technician	Facility ODCs	CEMS Consultant	Test Personnel
Decide on Approach	6 hr - gas pollutant monitoring; 2 hr - other monitoring				
Write Specification	40 hr - gas analyzers; 10 hr - monitor	4 hr - gas analyzers; 1 hr - monitor			
Identify Potential Bidders	2 hr - gas analyzers; 10 hr - monitor				
Write RFP and Guarantee	30 hr - gas analyzers; 10 hr - monitor				
Copy and Mail RFPs	5 hr		$100		
Respond to Bidders Questions	10 hr		$50		
Review and Evaluate Proposals	25 hr		$20		
Best and Final Meeting	6 hr - travel; $200 fare; 1 day per diem; 8 hr	2 @ 8 hr			
Select Winner	4 hr				
Negotiate Contract	35 hr				
Management during Manufacture and Install	20 hr - gas analyzers; 8 hr - monitor	10 hr - gas analyzers; 4 hr - monitor	$50		
Task 3 - Support Facilities					
Sampling Ports			$300 per analyzer port; $700 for monitor		

Activity	CEE	Plant Technician	Facility ODCs	CEMS Consultant	Test Personnel
Utilities - New Source			$1,000 for gas analyzers; $200 for monitor		
Utilities - Existing Source			$1,200 for gas analyzers; $300 for monitor		
Platform and Ladder			$0.00, can add $4,000		
CEMS Shelter			$0.00		
Task 4 - Purchase Hardware					
Opacity Monitor			$25,000, includes MCOC, ($18,000 for monitor)		
Gas Analyzers			$71,000 for SO2/NOx and CO/CO2; $10,000 for control unit		
DAS			$20,000		
Sampling System			$1,000 after control		
Task 5 - Install and Check CEMS					
Install CEMS		2 @ 16 hr - gas analyzers; 2 @ 16 hr - monitor			
Startup Equipment		2 @ 8 hr	$5,600		
Resolve Problems		8 hr	$1,400		
Calibrations		8 hr - gas analyzers; 5 hr - monitor			
Task 6 - Performance Specification Test					

Activity	CEE	Plant Technician	Facility ODCs	CEMS Consultant	Test Personnel
Select Test Contractor	16 hr		$50		
Pretest Meeting w/ Contractor and Agency	6 hr - Travel; $200 fare; 1 day per diem; 6 hr	4 hr			6 hr
Drift Tests		2 @ 14 hr	$300		
Performance Specification Test	8 hr; 1 day per diem	4 hr			2 @ 12 hr travel; 2 @ 24 hr; $100 fare; 2 @ 2.5 days per diem; $500 ODC; 10% fee
Write PST Test Report				2 hr - gas analyzers; 1 hr - monitor; 10% fee	16 hr - gas analyzers; 6 hr - monitor; $50 ODC; 10% fee
Review and Send Report to Agency	3 hr - gas analyzers; 1 hr - monitor	2 hr - gas analyzers; 1 hr - monitor			
Task 7 - Prepare QA/QC Plan					
Review Needs and Requirement	3 hr - gas analyzers; 1 hr - monitor	1 hr - gas analyzers; 1 hr - monitor			
Hire Consultant	16 hr		$50		
On-site Meeting	6 hr Travel; $200 fare; 1 day per diem; 4 hr	2 @ 4 hr		12 hr Travel; $600 fare; 1 day per diem; 12 hr; 10% fee	
Write Draft Plan				60 hr - gas analyzers; 20 hr - monitor; $50 ODC; 10% fee	

Activity	CEE	Plant Technician	Facility ODCs	CEMS Consultant	Test Personnel
Review and Comment on Draft Plan	6 hr - gas analyzers; 2 hr - monitor	2 @ 3 hr - gas analyzers; 2 @ 1 hr - monitor			
Write Final Plan				20 hr - gas analyzers; 5 hr - monitor; $75 ODC; 10% fee	
Get Agency Approval of Plan	4 hr				
Kickoff Meeting	6 hr - Travel; $200 fare; 2 days per diem; 8 hr	2 @ 2 hr		12 hr - Travel; $600 fare; 2 days per diem; 6 hr; 10% fee	

Activity	CEE	Plant Technician	Facility ODCs	CEMS Consultant	Test Personnel
Annual Costs					
Task 8 - Day to Day Activities					
Daily Check of Monitor (COMS)		0.5 hr/day for 320 days/year			
Daily Check of Analyzers (CEMS)		0.5 hr/day for 320 days/year			
Monthly Check of Analyzers (CEMS)		4 hr/month for 12 months/year			
Quarterly Check of Monitor (COMS)		6 hr/quarter	$250 annual		
Quarterly Check of Analyzers (CEMS)		8 hr/quarter	$1,200 annual		
Task 9 - Annual RATA					
Pretest Prep		2 @ 8 hr			
Hire Test Firm	2 hr				
Notify Agency	1 hr				
Conduct RATA		10 hr			2 @ 12 hr travel; 2 @ 20 hr; $100 fare; 2 @ 2.5 days per diem; $500 ODC; 10% fee
Take Corrective Action		4 hr x 35%			2 @ 4 hr; 10% fee; x 35%
Retest		4 hr x 35%			2 @ 4 hr; 10% fee; x 35%

Activity	CEE	Plant Technician	Facility ODCs	CEMS Consultant	Test Personnel
Write Test Report				2 hr; 10% fee	10 hr; $50 ODC; 10% fee
Certify and Send Report	2 hr				
Task 11 - Quarterly CGA					
Notify Agency	1 hr				
Do CGA		2 @ 4 hr x 3	$1,500 annual		
Take Corrective Action		4 hr x 3			
Retest		2 hr x 3	$150 annual		
Write Report, Certify and Send Report	3 hr x 3	3 hr x 3	$60 annual		
Task 12 - Recordkeeping and Reporting					
Daily Data Reduction		1 hr for 320 days/year for gas analyzers; 0.5 hr for 320 days/year for monitor			
Monthly Data Reduction	1 hr for 12 months/year for gas analyzers; 0.25 hr for 12 months/year for monitor	4 hr for 12 months/year for gas analyzers; 1 hr for 12 months/year for monitor			
Quarterly Emission Report	1 hr for 4 quarters/year for gas analyzers; 0.5 hr for 4 quarters/year for monitor	4 hr for 4 quarters/year for gas analyzers; 2 hr for 4 quarters/year for monitor			
Task 13 - Annual QA and O&M Review and Update					

Activity	CEE	Plant Technician	Facility ODCs	CEMS Consultant	Test Personnel
Meeting with Plant Technicians	6 hr - Travel; $200 fare; 1.5 days per diem; 2.5 hr - gas analyzers; 2 hr - monitor	4 @ 2 hr - gas analyzers; 4 @ 1 hr - monitor			
Update QA Plan	15 hr - gas analyzers; 5 hr - monitor		$50		
Update Equipment Inventory		6 hr - gas analyzers; 4 hr - monitor	5% of analyzers and monitor cost		
Training	6 hr - Travel; $200 fare; 2 days per diem; 8 hr	4 @ 16 hr	$2,600		

Appendix B

Extractive CEMS Base Case Labor and ODC Estimates Per Activity

Activity	CEE	Plant Technician	Facility ODCs	CEMS Consultant	Test Personnel
Capital Costs					
Task 1 - Planning					
Review Regulations	6 hr - gaseous pollutants; 1 hr - monitor				
Resolve Questions	6 hr - travel; $200 fare; 1 day per diem; 4 hr - gaseous pollutants; 1 hr - monitor				
Review Drawings	10 hr				
Inspect Source	6 hr during site visit for Resolve Problems; 1 day per diem	4 hr			
Define Specific Constraints - New Source	8 hr - gas analyzers; 2 hr - monitor				
Define Specific Constraints - Existing Source	12 hr - gas analyzers; 4 hr - monitor				
Write Engineering Report - New Source	16 hr - gas analyzers; 2 hr - monitor				
Write Engineering Report - Existing Source	20 hr - gas analyzers; 4 hr - monitor				

Activity	CEE	Plant Technician	Facility ODCs	CEMS Consultant	Test Personnel
Task 2 - Select Equipment					
Decide on Approach	6 hr - gas pollutant monitoring; 2 hr - other monitoring				
Write Specification	40 hr - gas analyzers; 10 hr - monitor	4 hr - gas analyzers; 1 hr - monitor			
Identify Potential Bidders	10 hr - gas analyzers; 10 hr - monitor				
Write RFP and Guarantee	30 hr - gas analyzers; 10 hr - monitor				
Copy and Mail RFPs	5 hr		$100		
Respond to Bidders Questions	10 hr		$50		
Review and Evaluate Proposals	40 hr		$20		
Best and Final Meeting	6 hr - travel; $200 fare; 1 day per diem; 8 hr	2 @ 8 hr			
Select Winner	4 hr				
Negotiate Contract	35 hr				
Management during Manufacture and Install	60 hr - gas analyzers; 8 hr - monitor	30 hr - gas analyzers; 4 hr - monitor	$1500		

Activity	CEE	Plant Technician	Facility ODCs	CEMS Consultant	Test Personnel
Task 3 - Support Facilities					
Sampling Ports			$365 - analyzer probe; $700 for monitor		
Utilities - New Source			$1,000 for gas analyzers; $200 for monitor		
Utilities - Existing Source			$1,200 for gas analyzers; $300 for monitor		
Platform and Ladder			$0.00, can add $4,000		
CEMS Shelter			$12,000		
Task 4 - Purchase Hardware					
Opacity Monitor			$25,000, includes MCOC, ($18,000 for monitor)		
Gas Analyzers			$37,290 for SO2, NOx, CO, and O2;		
DAS			$20,000		
Sampling System			$40,000 after control		
System Fabrication			$12,800		

Activity	CEE	Plant Technician	Facility ODCs	CEMS Consultant	Test Personnel
Task 5 - Install and Check CEMS					
Install CEMS - New Source		2 @ 48 hr - gas analyzers; 2 @ 16 hr - monitor			
Install CEMS - Existing Source		2 @ 60 hr - gas analyzers; 2 @ 16 hr - monitor			
Startup Equipment		2 @ 24 hr	$8,500		
Resolve Problems		16 hr	$2,900		
Calibrations		8 hr - gas analyzers; 5 hr - monitor			
Task 6 - Performance Specification Test					
Select Test Contractor	16 hr		$50		
Pretest Meeting w/ Contractor and Agency	6 hr - Travel; $200 fare; 1 day per diem; 6 hr	4 hr			6 hr
Drift Tests		14 hr	$300		
Performance Specification Test	8 hr; 1 day per diem	4 hr			2 @ 12 hr travel; 2 @ 24 hr; $100 fare; 2 @ 2.5 days per diem; $500 ODC; 10% fee
Write PST Test Report				2 hr - gas analyzers; 1 hr - monitor; 10% fee	16 hr - gas analyzers; 6 hr - monitor; $50 ODC; 10% fee

Activity	CEE	Plant Technician	Facility ODCs	CEMS Consultant	Test Personnel
Review and Send Report to Agency	3 hr - gas analyzers; 1 hr - monitor	2 hr - gas analyzers; 1 hr - monitor			
Task 7 - Prepare QA/QC Plan					
Review Needs and Requirements	3 hr - gas analyzers; 1 hr - monitor	1 hr - gas analyzers; 1 hr - monitor			
Hire Consultant	16 hr		$50		
On-site Meeting	6 hr Travel; $200 fare; 1 day per diem; 4 hr	2 @ 4 hr		12 hr Travel; $600 fare; 1 day per diem; 12 hr; 10% fee	
Write Draft Plan				80 hr - gas analyzers; 20 hr - monitor; $50 ODC; 10% fee	
Review and Comment on Draft Plan	6 hr - gas analyzers; 2 hr - monitor	2 @ 3 hr - gas analyzers; 2 @ 1 hr - monitor			
Write Final Plan				20 hr - gas analyzers; 5 hr - monitor; $100 ODC; 10% fee	
Get Agency Approval of Plan	4 hr				
Kickoff Meeting	6 hr - Travel; $200 fare; 2 days per diem; 8 hr	4 @ 2 hr		12 hr - Travel; $600 fare; 2 days per diem; 6 hr; 10% fee	

Activity	CEE	Plant Technician	Facility ODCs	CEMS Consultant	Test Personnel
Annual Costs					
Task 8 - Day to Day Activities					
Daily Check of Monitor (COMS)		0.5 hr/day for 320 days/year			
Daily Check of Analyzers (CEMS)		0.5 hr/day for 320 days/year			
Weekly Check of Analyzers (CEMS)		2 hr/week for 51 weeks/year			
Quarterly Check of Monitor (COMS)		6 hr/quarter	$250 annual		
Monthly Check of Analyzers (CEMS)		5 hr/month for 10 months/year	$2,500 annual		
Task 9 - Annual RATA					
Pretest Prep		2 @ 8 hr			
Hire Test Firm	2 hr				
Notify Agency	1 hr				
Conduct RATA		10 hr			2 @ 12 hr travel; 2 @ 20 hr; $100 fare; 2 @ 2.5 days per diem; $500 ODC; 10% fee
Take Corrective Action		4 hr x 35%			2 @ 4 hr; 10% fee; x 35%
Retest		4 hr x 35%			2 @ 4 hr; 10% fee; x 35%

Activity	CEE	Plant Technician	Facility ODCs	CEMS Consultant	Test Personnel
Write Test Report				2 hr; 10% fee	10 hr; $50 ODC; 10% fee
Certify and Send Report	2 hr				
Task 11 - Quarterly CGA					
Notify Agency	1 hr				
Do CGA		2 @ 4 hr x 3	$1,500 annual		
Take Corrective Action		4 hr x 3			
Retest		2 hr x 3	$150 annual		
Write Report, Certify and Send Report	3 hr x 3	3 hr x 3	$60 annual		
Task 12 - Recordkeeping and Reporting					
Daily Data Reduction		1 hr for 320 days/year for gas analyzers; 0.5 hr for 320 days/year for monitor			
Monthly Data Reduction	1 hr for 12 months/year for gas analyzers; 0.25 hr for 12 months/year for monitor	4 hr for 12 months/year for gas analyzers; 1 hr for 12 months/year for monitor			
Quarterly Emission Report	1 hr for 4 quarters/year for gas analyzers; 0.5 hr for 4 quarters/year for monitor	4 hr for 4 quarters/year for gas analyzers; 2 hr for 4 quarters/year for monitor			
Task 13 - Annual QA and O&M Review and Update					

Activity	CEE	Plant Technician	Facility ODCs	CEMS Consultant	Test Personnel
Meeting with Plant Technicians	6 hr - Travel; $200 fare; 1.5 days per diem; 5 hr - gas analyzers; 2 hr - monitor	4 @ 4 hr - gas analyzers; 4 @ 1 hr - monitor			
Update QA Plan	15 hr - gas analyzers; 5 hr - monitor		$50		
Update Equipment Inventory		16 hr - gas analyzers; 4 hr - monitor	10% of analyzers cost and 5% of monitor cost		
Training	6 hr - Travel; $200 fare; 2 days per diem; 8 hr	4 @ 24 hr	$3,500		

Appendix C

FTIR CEMS Base Case Labor and ODC Estimates Per Activity

Activity	CEE	Plant Technician	Facility ODCs	CEMS Consultant	Test Personnel
Capital Costs					
Task 1 - Planning					
Review Regulations	6 hr - gaseous pollutants; 1 hr - monitor				
Resolve Questions	6 hr - travel; $200 fare; 2 days per diem; 4 hr - gaseous pollutants; 1 hr - monitor				
Review Drawings	10 hr				
Inspect Source	6 hr during site visit for Resolve Problems	4 hr			
Define Specific Constraints - New Source	8 hr - FTIR; 2 hr - monitor				
Define Specific Constraints - Existing Source	12 hr - FTIR; 4 hr - monitor				
Write Engineering Report - New Source	14 hr - FTIR; 2 hr - monitor				
Write Engineering Report - Existing Source	18 hr - FTIR; 4 hr - monitor				

Activity	CEE	Plant Technician	Facility ODCs	CEMS Consultant	Test Personnel
Task 2 - Select Equipment					
Decide on Approach	6 hr - gas pollutant monitoring; 2 hr - other monitoring				
Write Specification	40 hr - FTIR; 10 hr - monitor	4 hr - FTIR; 1 hr - monitor			
Identify Potential Bidders	10 hr - FTIR; 10 hr - monitor				
Write RFP and Guarantee	30 hr - FTIR; 10 hr - monitor				
Copy and Mail RFPs	5 hr		$100		
Respond to Bidders Questions	10 hr		$50		
Review and Evaluate Proposals	40 hr		$20		
Best and Final Meeting	6 hr - travel; $200 fare; 2 days per diem; 8 hr	8 hr - tech; 8 hr - Tech II			
Select Winner	4 hr				
Negotiate Contract	35 hr				
Management during Manufacture and Install	50 hr - FTIR; 8 hr - monitor	tech 15 hr - FTIR; Tech II 10 hr - FTIR 4 hr - monitor	$1500		

Activity	CEE	Plant Technician	Facility ODCs	CEMS Consultant	Test Personnel
Task 3 - Support Facilities					
Sampling Ports			$365 - analyzer probe; $700 for monitor		
Utilities - New Source			$1,000 for FTIR; $200 for monitor		
Utilities - Existing Source			$1,200 for FTIR; $300 for monitor		
Platform and Ladder			$0.00, can add $4,000		
CEMS Shelter			$10,000		
Task 4 - Purchase Hardware					
Opacity Monitor			$25,000, includes MCOC, ($18,000 for monitor)		
FTIR Analyzer			$100,000;		
DAS			$0.00 for FTIR; $16,000 for monitor		
Sampling System			$37,800 after control		
System Fabrication			$7,700		

Activity	CEE	Plant Technician	Facility ODCs	CEMS Consultant	Test Personnel
Task 5 - Install and Check CEMS					
Install CEMS		2 techs @ 24 hr - FTIR; 12 hr - Tech II - FTIR; 2 @ 16 hr - monitor			
Startup Equipment		2 Tech IIs @ 24 hr	$5,090		
Resolve Problems		16 hr - Tech II	$2,200		
Calibrations		28 hr Tech II - FTIR; 5 hr - monitor			
Task 6 - Performance Specification Test					
Select Test Contractor	16 hr		$50		
Pretest Meeting w/ Contractor and Agency	6 hr - Travel; $200 fare; 1.5 days per diem; 6 hr	1 hr for tech; 3 hr for Tech II			6 hr
Audit Spectra Analysis		8 hr for Tech II	$300		
Validation - Compare to a RM and PM RCA	8 hr; 1 day per diem	4 hr for Tech II			2 @ 12 hr travel; 2 @ 24 hr; $100 fare; 2 @ 2.5 days per diem; $500 ODC; 10% fee
Write PST Test Report				2 hr - gas analyzers; 1 hr - monitor; 10% fee	16 hr - gas analyzers; 6 hr - monitor; $50 ODC; 10% fee

Activity	CEE	Plant Technician	Facility ODCs	CEMS Consultant	Test Personnel
Review and Send Report to Agency	3 hr - gas analyzers; 1 hr - monitor	2 hr for Tech II - FTIR; 1 hr - monitor			
Task 7 - Prepare QA/QC Plan					
Review Needs and Requirement	3 hr - gas analyzers; 1 hr - monitor	1 hr for Tech II - FTIR; 1 hr - monitor			
Hire Consultant	16 hr		$50		
On-site Meeting	6 hr Travel; $200 fare; 1.5 days per diem; 4 hr	2 Tech II @ 4 hr		12 hr Travel; $600 fare; 2 days per diem; 12 hr; 10% fee	
Write Draft Plan				80 hr - FTIR; 20 hr - monitor; $50 ODC; 10% fee	
Review and Comment on Draft Plan	6 hr - gas analyzers; 2 hr - monitor	2 Tech II @ 3 hr - FTIR; 2 @ 1 hr - monitor			
Write Final Plan				20 hr - FTIR; 5 hr - monitor; $100 ODC; 10% fee	
Get Agency Approval of Plan	4 hr				
Kickoff Meeting	6 hr - Travel; $200 fare; 1.5 days per diem; 8 hr	2 techs @ 2 hr; 2 Tech II @ 2 hr		12 hr - Travel; $600 fare; 2 days per diem; 6 hr; 10% fee	
Annual Costs					

Activity	CEE	Plant Technician	Facility ODCs	CEMS Consultant	Test Personnel
Task 8 - Day to Day Activities					
Daily Check of Monitor (COMS)		0.5 hr/day for 320 days/year			
Daily Check of FTIR		Tech II - 0.5 hr/day for 320 days/year			
Weekly Check of FTIR		Tech II - 1 hr/week for 51 weeks/year			
Quarterly Check of Monitor (COMS)		6 hr/quarter	$250 annual		
Monthly Check of FTIR		Tech II - 2 hr/month for 10 months/year	$6,500 annual		
Task 9 - Annual RATA					
Pretest Prep		8 hr - tech; 8 hr Tech II			
Hire Test Firm	2 hr				
Notify Agency	1 hr				
Conduct RATA		6 hr - tech; 4 hr - Tech II			2 @ 12 hr travel; 2 @ 20 hr; $100 fare; 2 @ 2.5 days per diem; $500 ODC; 10% fee
Take Corrective Action		4 hr Tech II x 35%			2 @ 4 hr; 10% fee; x 35%
Retest		4 hr Tech II x 35%			2 @ 4 hr; 10% fee; x 35%

Activity	CEE	Plant Technician	Facility ODCs	CEMS Consultant	Test Personnel
Write Test Report				2 hr; 10% fee	10 hr; $50 ODC; 10% fee
Certify and Send Report	2 hr				
Task 11 - Quarterly CGA					
Notify Agency	1 hr				
Representative Spectra Analysis and PM ACA		8 hr Tech II x 2			
Take Corrective Action		1 hr Tech II x 2			
Retest - not needed for FTIR					
Write Report, Certify and Send Report	No report needed for FTIR				
Task 12 - Recordkeeping and Reporting					
Data Reduction		Tech II - 7 hr/wk for 51 weeks/year for FTIR; 0.5 hr for 320 days/year for monitor			
Monthly Data Reduction	1 hr for 12 months/year for gas analyzers; 0.25 hr for 12 months/year for monitor	Tech II - 4 hr for 12 months/year for FTIR; 1 hr for 12 months/year for monitor			

Activity	CEE	Plant Technician	Facility ODCs	CEMS Consultant	Test Personnel
Quarterly Emission Report	1 hr for 4 quarters/year for gas analyzers; 0.5 hr for 4 quarters/year for monitor	Tech II - 4 hr for 4 quarters/year for FTIR; 2 hr for 4 quarters/year for monitor			
Task 13 - Annual QA and O&M Review and Update					
Meeting with Plant Technicians	6 hr - Travel; $200 fare; 1.5 days per diem; 5 hr - gas analyzers; 2 hr - monitor	2 techs @ 4 hr - FTIR; 2 Tech II @ 4 hr - FTIR; 4 @ 1 hr - monitor			
Update QA Plan	15 hr - gas analyzers; 5 hr - monitor		$50		
Update Equipment Inventory		10 hr - FTIR; 4 hr - monitor	$20,000 for FTIR and 5% of monitor cost		
Training	6 hr - Travel; $200 fare; 2 days per diem; 8 hr	2 techs @ 10 hr; 2 Tech IIs @ 20 hr	$3,500		